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Expanding the integration of technological education and industry through research into developed cost forecasting and control strategies for contractors with the incorporation of econometric models

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ABSTRACT: Demands are being made on the post-Olympic Greek Property Market (PO-GPM) to produce low cost, quality affordable buildings with long-term useful lifespans and by Greek governmental bodies to increase revenues from property taxation, which require professionals engineers who are more educated and trained in cost engineering. The Greek construction industry, despite of years of training and growth, remains notorious for its inability to forecast and control costs within the budget constraints, discouraging private, public and international investments in new multimillion Euro construction projects. To make the construction attractive to investors and properties affordable to the citizens, the industry must show its ability to forecast, control and report accurately. The cost forecasting and control strategy for the Greek construction industry has been developed and the applied property techniques can be used to make forecasts on the property market. In this paper, the author argues that the expansion of the integration of engineering and technological education and industry through the developed cost forecasting and control strategy and the incorporation of econometric models, can provide an improved approach for understanding property market interactions, forecasts and profits, and finally benefit all parties.

INTRODUCTION

The role of the *professional engineers and estimators* in the period of the post-Olympic Games economic development in Greece must be closed to industry and property market needs, providing better services for citizens, financial institutions and investors.

The role of the *university* or *higher educational institutions* in this age of transformation must be a leading one and one that is closely bound in this increasingly global market to industry and its needs [1].

The Greek construction industry could benefit from the development of cost forecasting and control strategies for better-cost management and practices. The integration of Engineering & Technological Education (E&TE) and industry can provide the mechanism to bring together the critical demands in the Greek real estate market in order to produce low cost, quality, affordable buildings with long-term, remaining useful life [2]. The Greek governmental bodies plan to increase revenues from property taxation. The expansion of integration is vital in order to provide an improved approach for a better understanding of property market interactions, forecasts and profits. Professionals should be able to manage development projects respecting the relevant legislation, building environment and engineering technology, citizens' affordability and investors' contributions.

This article is structured as follows: first, globalisation is discussed with a brief review of the developed cost control and forecasting strategy for the Greek construction industry and its consequences. Second, the Greek residential model and a review of professionals' concerns is discussed. Third, applied property research techniques are analysed with an emphasis on econo-metric models (regression models). Finally, there is a brief review of the property market and the author's conclusions.

GLOBALISATION AND A REVIEW OF THE DEVELOPED COST CONTROL AND FORECASTING STRATEGY: CONSEQUENCES

Badran stated the following:

> *Globalisation is a new challenge to engineering education … Universities will increasingly compete in two areas. The first is quality of education … Secondly competition will be in research and development (R&D) …* [notably] *quality of research … In terms of the global view, just a handful of industrial countries carry out over 80% of world research* [1].

Molson's remarks are as follows:

> *The ability of the Greek Engineering Model (GEM) to satisfy the current and future needs of the European Industry, the European Union, the international mobility and the life-long commitment to learning/training, defines the quality of technological engineering education within the educational system in Greece* [3].

By 2010, engineering education will have changed significantly from what it is now [4]. The growing demand for specialists, who have both engineering skills and management abilities, has changed the image of the engineer's role in the industrial process, real estate market and consultancy [3]. Today, practitioners and graduate engineers have to work in a global information and knowledge society, and demonstrate their knowledge [5]. This knowledge spans the Greek and other construction industries, construction and information technology, construction and project management, the fields of property development and management, value engineering, as well as cost engineering and project control. Graduates must

also show their ability to control costs and manage risks in both the design and construction phases.

The author states that many Greek professionals have limited understanding of global engineering issues and academia-research achievements in their field of responsibility and applications (eg project control, cost management, project planning, risk analysis, developed strategies, cost forecasting and control, etc.), as well as the incorporation of applied property research techniques for property development.

The under-funding of cost engineering services (expensive management functions or low funding available), the use of highly subjective techniques and a lack of logical thinking (just one application for many projects) also have an impact.

The author has affirmed that the construction sector has widely been regarded as an important contributor to economic welfare in Greece due to its substantial influence on the development of basic macroeconomic indicators and employment of the labour force.

However, despite years of long-term training to obtain value for money, the Greek construction industry remains notorious for its inability to complete project within budgetary constraints (eg the Egnatia national dual motorway had an initial budget of €2.5 billion in 2001 but is expected to have a total cost of €6.5 billion by 2008) [2]. To make construction attractive to clients and international investors, the Greek construction industry must demonstrate a long-term ability to control costs and produce accurate forecasts. Only in this way will clients and investors have the confidence to commit funds to residential properties and new multimillion Euro construction projects, respectively. The formulation of a strategy that accurately predicts cost indices and approaches cost control systematically could lead to a better construction market, efficient control and better value for money, and finally benefit all parties.

A developed strategy is formulated for the use of contractors [6]. The specifications of this strategy are discussed in terms of inputs, processes and outputs. The strategy covers two following stages in the construction process, namely:

- Pre-tender, which combines productivity and *historical cost* data, forecasting cost indices using the developed decomposition model, the development of a planning process, and the integration of a project plan with the forecasted cost indices to produce costs;
- Construction stage, which combines: open a budget, capture data on site and develop construction reports. A modified PERT-cost system was developed to control costs using a closed loop-feed forward control approach.

This strategy is basically concerned with the Greek traditional procurement method. The bidding procedure is evaluated for open, two-stage and negotiated tenders, but it could be used for the development approach (residential sector) and also for the value engineering study (eg the *presentation phase*). For example, public-private partnerships are one of the key developments that will drive change in the Greek construction industry over the coming 15 years.

In the Greek construction industry, it has been recommended that contractors should reorganise their practices regarding cost control and forecasting. The criteria for improving the current practices are: the forecasting process, better cost control, construction quality, new construction methods, modern plants, cost management; information technology and cost control at the initial design stage. In short, any decision to establish a cost control and forecasting system in the construction process would influence positively the growth of the construction market.

Since 1996, many Greek construction firms have invested in cost control departments due to the reduction of profit margins, globalisation and hard competition [2]. During the post-Olympic crisis, many firms developed estimating and valuation systems. Cost forecasting is a forgotten service in Greece because local professionals lag far behind their international counterparts in both research programmes and industry-academia partnerships. Greek firms are increasingly multi-national, operate in several nations (for example, Greece, Romania, Bulgaria, Ukraine, etc) and must know the best location for investment in order to succeed economically; their professional engineers should also be skilled in local construction practices, understand property forecasts and perform accurately to the requirements of investors.

Today, the industrial (internal and external industrial customers) requirements in cost engineering and process areas are: risk management-analysis, cost modelling, cost control and analysis, value engineering and cost reduction, supply chain management, cost allocation, business case development, capital assets and resources management, design to cost and Cost As an Independent Variable (CAIV), purchase, budget forecasting, cost estimation, systems and software system acquisition and maintenance, bid/no-bid decisions, etc [7]. A vital aspect of a good engineering education and professional training must be students' exposure to the impact of improving technical knowledge in the fields of probability, statistics and forecasting, cost management and information technology. However, the extension of integrating E&TE and industry with the incorporation of econometric models in order to forecast property markets is also needed to recognise their interactions.

THE GREEK RESIDENTIAL MODEL: A REVIEW OF CONCERNS

Demands are being made by the Greek property market (clients, practitioners and users) to produce low cost, quality, affordable buildings with-long term remaining useful life and by the Greek Ministry of Economy and borough councils to increase revenues from property taxation, eg new objective values. This requires professional engineers to be educated and trained in cost engineering, including topics such as forecasting and applied property research techniques. Thus, new engineers would develop those skills considered essential for modern forward-thinking organisations.

Over the last decade, Greece was marked by remarkable real estate development, mainly due to a sharp increase of financing availability and the decrease of financing costs [8]. The development of the real estate market resulted in a significant increase in the number of privately owned residences (up to 83% in 2005 with a trend > 85%) and to higher prices than the decrease in the cost of borrowing (1997-2007).

The housing production process and supply have traditionally been controlled by the private sector in modern Greece. There has been limited involvement by public organisations (eg OEK) and the Greek Orthodox Church, resulting in a huge individual citizens' debt in modern Greek economic history due to house buying and small constructors loans [2].

The economic policy for changes in the Greek property tax framework have monopolised the property and construction markets (especially in the residential sector) in the period 2005-2006, forcing many citizens to invest in properties – especially residential and land plot properties. Further, contractors have to submit and authorise building proposals in advance (which increased 124% by December 2005) before the new VAT law was applied in January 2006. Both of these aspects yielded peak prices. The construction cost escalation has monopolised the residential construction market in the year 2006-2007. Property owners tried to accelerate the promotion process in order to avert increases in the objective values by January 2006 and also in 2007, respectively.

The main characteristics of the residential market are described below:

> *Constant the income of citizens of – households; High asking prices; Householders' financial statements; Progressive reduction of demand; The loans constitute the main source of financing in the residential sector; The rental values remain constants and in a lot of cases present reduction* [9].

The author affirms that banks, money lending institutions, government and private organisations have not secured their returns on huge investments in the construction market because of the lack of development of a proper cost control and forecasting strategy in the construction sector [9].

According to Lefteris Tasoulas, *the uncontrolled expansion of the Capital* has resulted in a further deterioration of the urban environment [10]. There is also a need to reform developed areas and any actions should be carefully targeted with simple and far-sighted intervention so as to regain its lost human face.

According to Simaioforidis, Greek cities and their broader urban districts need great interventions, which will ensure a functional and rational infrastructure network, drains, telecommunications and transportation [11].

Modern residential properties should respect the legislation, building environment and engineering technology, and be affordable for citizens. They should also contribute to the economic and social welfare of Greece. Thus, it is essential that universities provide students with the best opportunities for success in the job market so that they have enough understanding to make decisions that assist, rather than hinder, the advancement towards sustainable development [12].

APPLIED PROPERTY RESEARCH TECHNIQUES: ECONOMETRIC MODELS

In general, *forecasting* is the process of *estimating or predicting* the *future*. The principle aim of *forecasting* is to *provide reliable estimates of future projects that will assist management in making accurate decisions; and producing sound plans for the future* [6][13]. The key of this success is the *quality of the information*, which ensures greater accuracy in the forecasting process.

In the context of applied property research techniques, *forecasting* means using econometric methods (such as a regression model) to predict the future value(s) of an *economic* variable (regression models are also known as econometric models) [14].

Basically, there are two approaches to forecasting: the *subjective* approach, which is based on human judgement, and the *objective* approach. Subjective or informal techniques are listed as follows:

> *Jury of executive opinion for medium long term forecast; Sales force estimate; Customer expectations; Judgmental techniques; Survey methods and Public scrutiny* [13].

The objective approach is scientific, quantitative in nature and tends to assume elements of continuity between past, present and future. The main objective techniques to be considered are mathematical trend projections and the *econometric approach*. The main objective techniques include the following:

> *Box-Jenkins' time series; Classical decomposition for medium term forecast; Exponential smoothing; Moving average for short term forecast; Regression for long term forecast and Trend line analysis in medium long term of forecast* [13].

Regression Models

Although simple regression has the potential to be a powerful research tool, its extension, multiple regression analysis, is used more widely in property market research. Multiple regression analysis differs from simple regression analysis in that more than one explanatory or independent variable is used [14].

A linear regression line (simple regression) has an equation of the form:

$$Y = a + bX \tag{1}$$

where X is the explanatory variable and Y is the dependent variable. The slope of the line is b, and a is the intercept (the value of y when $x = 0$).

The assumption underlying multiple regression analysis is that a combination of explanatory or independent variables determines the dependant variable. The multiple regression assumptions are the same as those for simple regression analysis except that there is one additional assumption in multiple regression analysis [14].

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon_i \tag{2}$$

where,

- Y_i : The ith observation of the dependant variable;
- β_1 : The (unknown) constant or intercept of the equation;
- β_2 : The (unknown) parameter of the first independent variable, X_2;
- X_{2i} : The ith observation of the first independent variable;
- β_3 : The (unknown) parameter of the second independent variable, X_3;
- X_{3i} : The ith observation of the second independent variable;
- ε_1 : The error term or residual for the ith observation.

The regression equation for a multiple regression design for the first-order effects of three continuous predictor variables P (net annual household income), Q (household size), and R... would be:

$$Y = b_0 + b_1P + b_2Q + b_3R \ldots \quad (3)$$

where Y: annual household expenditure on housing.

Finally, the performance of an econometric forecasting model is partly dependent upon the quality of the data used to estimate the parameters of the model.

GREEK PROPERTY MARKET BRIEFING

In the Greek property market, many developers/investors are still wary of financing developments at this stage of cyclicality in the post-Olympic crisis. A declining trend of employment in building and public works followed the completion of the Olympic Games works and resulted in the construction industry entering a period of recession. Moreover, the organisation of the Olympic Games contributed to the rapid development of the Greek property market following the construction boom (especially in the Attica district); it is expected by property consultants and estate agents that the operation and utilisation of infrastructure projects will rapidly transform the image of regional markets, especially with funds from the fourth Community Support Framework.

The residential sector covers 70% of all sectors due to the residential credit system (bank loans and mortgages) and the need for better housing, applying modern building technology and engineering. The development pipeline in the housing sector is still requires additional contracting supply and the simultaneous execution of construction projects, despite an increase in the vacancy rate in the period 2004-2006 and an enormous interval in the period 2006-2007. Developers' confidence in growth does not rely on economic performance and employment growth, but rather relays the increasing pressure for higher rental and sale values in the period 1997-2005. For example, average prices increased by 17.6%, 16.2% and 14% in years 2001, 2002 and 2003, respectively. Contractors remembered, firstly, the major increase of housing prices in the Attica and Thessaloniki districts in the period 1997-2001, and secondly, the continued growth of values in the period 2002-2006, and desire higher prices and more profits, based at lowest construction cost [2].

Astronomically high property prices have to be avoided in the Greek real estate market in the future, especially in the housing sector. The new code for sustainable homes demands higher standards for energy efficiency and it will be made mandatory for both existing and new homes [2].

CONCLUSIONS

The Greek property market produces expensive products with low returns and high maintenance costs in the long-term period, which discourages users, investors and new buyers. Simultaneously, the housing credit system faces a reduction of applications for housing mortgages for the period 2006-2007. Thus, professionals must understand property market interactions, the parameters of the residential sector, new standards/directives, and should be able to demonstrate their knowledge and skills in the integration of engineering technology and industry. The developed cost forecasting and control strategy for the Greek construction industry and the objective techniques can be used to forecast changes in the property market with an emphasis on the housing sector.

The expansion of the integration of E&TE and industry through developed cost forecasting and control strategies, as well as the incorporation of econometric models, can provide professionals with the basic mechanisms to understand the Greek property market interactions, forecasts and profits, and finally benefit all the parties involved.

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